Detection of fungal growth on food material using spectral imaging

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Introduction and Objectives: Microbial contamination of food material is a serious issue in the food industry, mainly because of toxin accumulation. Reflectance multispectral imaging is one novel method in which reflected light from a sample is captured by an image sensory device. *Aspergillus flavus* is a major fungal food contaminator and produces mycotoxins. The objective of the current study was to investigate the possibility of using multispectral imaging to detect the growth of *A. flavus* on food substrates.

Method: *A. flavus* isolated from coconut fruits was inoculated onto a bread slice (8cm × 8cm) in triplicate and incubated in a moist chamber with the control inoculation with 0.5 ml of sterile distilled water. After 0-, 3-, 5- and 6-days post-inoculation, the bread samples were ground to a fine powder after oven drying at 50 °C to a constant weight. An amount of 3.00 g was subjected to multispectral imaging with illumination at 365 nm - 940 nm wavelength. The spectral signature was plotted with the average intensity of cropped images of each sample against the spectral wavelength. A separation among spectral signatures owing to day 0, day 3, day 5 was observed. There was no distinction between spectral signatures of days 5 and 6 due to the saturated growth of the fungus by day 5. Therefore, the dataset was analysed both with and without samples of day 6. Machine learning and data analytic techniques (Logistic Regression, Support Vector Machines and Decision Tree classifier) and linear regression were applied to the dataset. The algorithms were trained using the train dataset (75% of the original dataset). All the models were tested using the test dataset (25% of the original dataset).

Results: With the full dataset, all classifiers showed around 90% accuracy while the regression model produced a R^2 value of 0.98. Without the samples of day 6, all classifiers showed 100% accuracy while the regression model produced a R^2 value of 0.995.

Conclusions: It can therefore be concluded that multispectral imaging combined with machine learning provides a good solution for fungal growth level estimation.

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Keywords: *Aspergillus flavus*, spectral analysis, mycotoxins, machine learning, multispectral imaging.

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